PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

PLANTERS' BULLETIN FORTY

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EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 72051. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and advice of despatch should be given by letter or telegram.

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PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur January 1959 Number 40

Editorial: Critical Interpretation of Yield Records

It is fitting that, in this issue of the *Planters' Bulletin* in which our Planting Recommendations 1959 – 60 are published, we should draw attention to the necessity for critical examination of all yield records and to the dangers of taking them merely at their face value. Yield records can be presented in a number of different ways, most of which have their particular advantages, and none of which can alone present an accurate detailed picture. The purpose of any particular type of yield record should determine the form in which it is presented. The limitations should be fully understood.

Two main types of yield record can be readily recognised; firstly, those from large areas of rubber under commercial tapping, and secondly, those from small observation plots or statistically designed trials, the purpose of which is to compare promising new selections. Records from large rubber areas usually take the form of unit weight of dry rubber per unit area per unit of time, or of unit weight of dry rubber per task, while those from observation plots or variety trials are more often presented as unit weight of dry rubber per tree per tapping, per tree per unit of time or of percentage of the yield of the control clone.

It would be nonsensical to present the yields of large commercial areas in terms of yield per tree per tapping or per year, since such yields are intended primarily to provide information upon which commercial interests can broadly compare the economical advantages of different fields, planting materials or methods of tapping and husbandry. Yields of a commercial planting depend not only on the inherent yielding capacity of the planting material, but also on soil conditions, which may differ markedly within one field, incidence of wind damage and disease and on every cultural procedure employed. Great accuracy in recording such yields is not required because there are many factors involved, whose effects defy accurate assessment. Nevertheless, yields from commercial plantings in the form of pounds per acre per year can be used to make general comparisons of the yield capacity of different planting materials, if a sufficient number of records can be collected from a wide range of districts and cultural conditions. The R.R.I. collects yield records from all over Malaya for this purpose.

Occasionally it is necessary to consider yields per acre over a period of less than a year. In order to make a rough comparison of such

figures with yields for the full year, a conversion is made to yield per acre per year by multiplying the mean yield per month by twelve, and qualifying the resulting figure by adding the phrase 'at the rate of'. The accuracy of the comparison depends on the time of year the yields were recorded. During wintering trees yield much less than in November or December. The risks of misinterpretation are obvious.

The danger of misinterpreting yield records from small plots or variety trials is much greater. In the small scale trials at the R.R.I. Experiment Station, many clones derived from hand pollinated seedlings must be tested for vigour and yield before the most promising can be selected for more intensive testing in larger trials. The number of trees in tapping of each clone in these trials does not exceed eight. The mean yield of the trees of each clone is calculated and expressed as grams per tree per tapping. These figures have no value other than for selection of the highest yielding clones in the trial for testing on a larger scale. Multiplying the yields per tree per tapping by the number of tappings per year and by a hypothetical number of trees per acre would result in a figure for yield per acre per year which would not only be useless, but highly misleading. At such an early stage of testing insufficient information is available on such important points as susceptibility to brown bast and wind damage.

The best yielders are then compared in statistically designed large scale trials and may each occupy an area of about an acre. Yield per tree per tapping is still an important measurement at this stage of testing, but in addition the yields per acre per year can be calculated from the task records. It is important that they are not calculated directly from the yield per tree per tapping figures. Both forms of yield record must be taken into account in comparing the clones. A clone which is a high yielder per tree may be a low yielder per acre, as the number of trees tapped may be small because of lack of vigour or wind damage.

The only advantage of expressing the yields of clones under trial as percentages of the yield of the control clone is to enable the reader to see at a glance their performances in relation to the control clone. No additional information is provided by such percentage figures, which should not be used unless the actual yields, in appropriate form, are also provided. For example, the control clone may not be suited to the particular locality or it may have been suppressed in growth by more vigorous neighbours, so that its yield may be rather less than could be expected of the particular clone. If the yields are provided, this will be noted and allowances made accordingly in the interpretation of the yield figures. If percentages of control are given alone, the performance of the clones under test will be correspondingly exaggerated. The danger of misinterpretation is greatly increased if the yields of clones under trial in different localities are given as percentages of a control clone common to each site.

Care should be taken in using the avoirdupois and metric systems.

We suggest that where the absolute yields are of less importance than relative yields, as in small scale trials and yields per tree in large scale trials, the gram should be the unit used. Readers would then be warned, when they see yields expressed as grams per tree, that the yields are published only as a means of comparing the yield capacity of the clones and are not of any use in calculating possible commercial yields. The pound would be reserved for unit weight per acre per year, or per task.

Planting Recommendations, 1959-60

OUR PLANTING RECOMMENDATIONS for 1957–58 were published in *Planters' Bulletin 28* and the present article brings them up to date with more detail on the performance and characteristics of some of the clones.

As before, we classify planting material as being suitable for large scale planting (up to eighty per cent of the area in aggregate), moderate scale planting (up to twenty per cent of the area in aggregate) and experimental scale planting. The one change that has been made in this classification is that the maximum area advised for material recommended for experimental planting is twentyfive acres instead of twelve acres. We have found that twelve acres is very often an unsuitable area for estate purposes, and consider that the increase in area constitutes very little risk with selected experimental material. We hope that estates which adopt the policy of using twentyfive acre blocks of experimental material will eventually be able to provide us with reliable yield records which will be taken into consideration in making our future recommendations.

The present recommendations are based on yield records and observations from the R.R.I. and other research organisations, combined with records from commercial plantings in the case of material recommended for large and moderate scale planting. The performance of planting material is governed largely by two factors. Firstly, the excellence of supervision and upkeep cannot be over-emphasised; without constant care even the best material will be disappointing. Secondly, environment must be taken into account particularly in the case of certain clones. It is for this reason that we advise planters to have a few blocks of clones in the experimental class; without this cooperation it will take much longer to discover how new clones react to particular environments and thus promotion to moderate or large scale plantings will be retarded.

As we have emphasised in previous articles, no clone or seedling family is the best planting material under all circumstances or for all purposes, and only after careful consideration of all the relevant points can a final choice of material for a particular area be made. We give later in this article descriptions of some of the clones and notes on

their peculiarities. Although these notes must inevitably be generalisations, such characteristics as relative vigour, susceptibility to disease and wind damage and suitability of crop for the various types of processing can all be taken into consideration when choices are being made for a particular locality. Some clones which still find favour on certain estates are omitted from the recommendations given in this article. For example, Sab 24 yields very well on certain coastal estates, and plantings of this clone in localities where it has been proved to be better than some of the clones mentioned here are no way contrary to our recommendations.

The choice between buddings or clonal seedlings is difficult and is easily influenced by prejudice. Reference should be made to our article dealing with this subject which was published in *Planters' Bulletin 36* (May 1958) giving the main conclusions which were that buddings presently available are in general superior to seedlings in yield, and with them it is easier to achieve a uniform stand. The variability of clonal seedlings, on the other hand, renders them less likely to suffer severely from specific disease, and results in the production of latex which is of average quality for any manufacturing process. One point that must be made quite clear is that without adequate selection of seedlings in the nursery and subsequent thinning in the field, even the best clonal seedling family will cause disappointment. The necessity for ensuring that clonal seed supplies come from a reputable source is obvious.

As far as possible we have attempted in the present article to mention the properties of latices of the recommended clones but undue importance should not be attached to our comments on them. Although latex properties are clonal characteristics, they vary greatly according to circumstance; for example, they depend on the age of the tree, the time of year and the soil type. The latex of some of the clones mentioned here has been tested from only one site and while the results of the test may be useful as a general indication, they are not necessarily applicable to areas elsewhere.

Precoagulation trouble with latex may often be corrected by the use of anti-coagulants, changes in tapping system or, on a long term basis, by manurial treatment. A proportion of the yellow colouring matter in latex may be removed by bleaching agents and certain other troublesome characteristics may be overcome with other chemicals. Serious difficulties in processing usually only arise with latex from large monoclonal blocks and then only in a very small percentage of cases. Thus undue importance should not be attached to the latex properties of clones recommended for experimental planting.

The material recommended for planting is given below:

CLASS I — For planting on a large scale, up to eighty per cent of the area in aggregate.

Clones PB 86, Tjir 1, PR 107, RRIM 501, RRIM 513 and Gl 1.

Clonal seedlings Prang Besar Isolation Garden Seed from plots D, F and G, Prang Besar 'Further Proof A', and 'Further Proof B', Chemara Isolation Garden Seed 'B' and 'E' and Tjir 1 and from monoclone plantings or from approved collection areas with other good parent clones.

CLASS II — For planting on a moderate scale, up to twenty per cent of the area in aggregate.

Clones LCB 1320, GT 1, RRIM 519, RRIM 526, Prang Besar Further Proof 5/51 and 5/63 and Ch 26.

Clonal seedlings seed collected from boundaries between plantings of good seed parents such as Tjir 1, AVROS 157, Br 2, Pil B84, RRIM 501, PR 107, GT 1 and LCB 1320.

CLASS III — For plantings on an experimental scale of up to twenty-five acres.

Clones RRIM 600, 603, 605, 606, 607, 610 and 623; PB T 157, T 207, T 495, 28/83, 28/59 and 5/76; Ch 30 and 32; Nab 12, 15 and 20; IRCI 7 and OY 1; War A9. Clones from the 1954 exchange collection: WR 101, PR 226, PR 228, PR 231, AVROS 427, 529, 1191, 1734 and 1447 from Indonesia; RRIC 1, 6, 7, 22 and 45 from Ceylon and IRCI 2, 3, 6, 9 and 10 from Indochina all of which are recommended in their countries of origin. Budwood is now available in limited quantities from R.R.I. Experiment Station. The maximum order permitted will be five yards of each clone. The usual form of agreement must be signed.

Clonal seedlings illegitimate seedlings of high yielding clones not previously tested and collected from areas uncontaminated by seedling or stock shoots.

The changes from our 1957–58 Planting Recommendations are:

MATERIAL RECOMMENDED FOR LARGE SCALE PLANTING (CLASS I)

Prang Besar 'Further Proof A' and 'Further Proof B' and Chemara Isolation Garden Seed 'B' and 'E' have been upgraded from class II (note that C.I.G.S. 'B' is often in short supply) on the strength of commercial records we have received.

MATERIAL RECOMMENDED FOR MODERATE SCALE PLANTING (CLASS II)

Ch 26 has been upgraded from class III.

MATERIAL RECOMMENDED FOR PLANTING ON EXPERIMENTAL SCALE (CLASS III)

RRIM 613, 616 and 626 have been discarded because of their susceptibility to wind damage.

RRIM 601, 602, 604, 608, 609, 611, 612, 614, 615, 620, 621, 622, 624, 625, 628, 629 and 630 are not at present showing particular promise but have not been discarded as some of them may eventually prove to be better than those which are now in favour. We suggest that small observation plots of an acre or so each should be budded with some of these clones to determine their suitability for different localities. For example, RRIM 614 is a high yielder but has shown a tendency to wind damage on some sites and not on others.

BRIEF NOTES ON SOME OF THE RECOMMENDED CLONES

For Large Scale Planting

PB 86 — A clone of moderate vigour with slow growth in the early years and for this reason particular care should be taken of its upkeep. It should not be planted on poor soils. The crown is open and very resistant to wind. In spite of its moderate vigour PB 86 is still one of the best all round clones in Malaya. Its latex is usually of high mechanical stability and suitable for the manufacture of concentrated latex, but latex from young areas may be unstable. It is suitable for pale crepe and smoked sheet. Provided it is growing well, the bark characters and bark renewal are average to good. It is one of the clones least susceptible to brown bast. PB 86 is a prolific seeder and may flower and fruit in the third or fourth year of growth. The seed, however, is not recommended for collection as clonal seed or for stocks if seeds from other more vigorous clones are available.

Tjir 1 — A clone whose heavy branches produce a weak junction with the main stem, which with its dense heavy crown when young, makes it liable to wind breakage when planted in exposed situations, and to wind fall on soils with a high water table. The crown can be improved by early pruning. It is vigorous and grows relatively well on average to poor soils. It is one of the lowest yielding of the older clones still being planted in Malaya and should not be chosen when the soil is good unless seed production is a secondary consideration. As a seed parent it is one of the best known clones. The colour of the latex varies according to the site but is usually yellow, making it unsuitable for the manufacture of pale crepe without fractional coagulation or the use of bleaching agents. The latex is usually stable but may give trouble during wintering. The bark characteristics are good, although it is more susceptible to brown bast than PB 86.

RRIM 501 — This is the highest yielding clone recommended for large scale planting in Malaya. It shows outstanding vigour on coastal soils and on good inland soils and when properly tended is probably one of the earliest maturing clones in current use. It has a good habit. Although previously we stated that it was not susceptible to wind damage we have now received several records of severe wind damage, which usually takes the form of breaking of the main trunk below the

branches. This has occurred in the early years of tapping, and is more or less confined to the coast stretching from around Port Dickson to Klang and on a parallel belt inland. One of the factors which appears to be involved is over-manuring with sulphate of ammonia. Nevertheless, over the bulk of Malaya, the clone does not appear to suffer from wind damage. Bark characters are average and the brown bast incidence is low. RRIM 501 is susceptible to pink disease, which can be controlled economically, particularly over the period from three to seven years after budding. No further treatment is required after the canopy closes over. The stability of the latex concentrate increases to a high value during the second and third months of storage.

It produces a pale yellow soft crepe and a soft smoked sheet which is a disadvantage if latex from other sources is not mixed with it.

RRIM 513 — In the same high yielding class as RRIM 501 but is less vigorous, although more vigorous than PB 86, and should therefore be avoided on poorer soils. It has a very heavy crown and trees may lean on poorly drained soils. It is resistant to wind break. Virgin bark and first renewed bark are a little below average thickness. Like PB 86, it has latex suitable for all manufacturing processes.

PR 107 — A vigorous clone with an exceptionally good habit. The crown is well balanced and particularly resistant to wind damage. Yield records received from post-war plantings of this clone have been disappointing, even though stands come into tapping early compared with such clones as PB 86 and RRIM 513. The indications are that PR 107 is a late starter and that yields will improve considerably, but it is unlikely that it will ever attain the same class as a yielder as RRIM 501 or RRIM 513. The latex is white but it has a low mechanical stability and is unsuitable for concentration without treatment. Estates which already have large areas of this clone are advised not to plant more until yields from the twelfth year onwards are available.

Gl 1 — A moderately vigorous clone with an open well balanced crown and dark green foliage. It does well on most coastal soils and the better inland soils and is very resistant to wind damage. It is extremely susceptible to brown bast and is therefore entirely unsuited to a 100 per cent intensity tapping system, particularly full spiral fourth daily, but can yield well on a half circumference third daily system. The latex is mechanically unstable and unsuitable for concentration. Pre-coagulation and processing difficulties often occur with RSS and crepe manufacture. On estates where the clone has been particularly successful we feel that extension of planting would be justified.

For Moderate Scale Planting

LCB 1320 — A vigorous clone which tends to develop a lopsided crown which is susceptible to wind damage unless corrective pruning is undertaken to promote branching when the trees are twelve to fifteen feet tall. It should not be planted on exposed situations. It has only recently come into tapping in Malaya and yields are promising. It is

recommended on the strength of its performance in Java, where it is one of the highest yielding clones. Its bark is thick and its latex is suitable for the manufacture of pale crepe and reasonably suitable for concentration.

GT 1 — A fairly vigorous clone on good soils but it appears to be sensitive to environment in this respect. Growth during immaturity can be poor if conditions are not suitable. It has a straight stem and compact crown and is resistant to wind damage. It is one of the highest yielding clones in Indonesia where it is recommended for large scale planting. The virgin bark is thick and renewal is good. From limited tests, the latex appears suitable for manufacture of pale crepe and for concentration.

RRIM 519 — A vigorous high yielding clone with a clumsy habit but good virgin bark and bark renewal. It is not susceptible to brown bast or to wind break but may lean or fall on soils with a high water table. The latex is not very suitable for concentration and is slightly yellow for the purpose of crepe manufacture. It has yielded more than RRIM 501 and RRIM 513 in one of our trials and in general can be considered in the same class as a yielder.

RRIM 526 — A vigorous high yielding clone with an attractive habit. It is resistant to wind damage. Virgin and renewed bark thicknesses are good. The latex is slightly yellow but is suitable for the manufacture of pale crepe and for concentration. This clone appears to be resistant to pink disease and for that reason may be preferred to RRIM 501 where the disease is prevalent.

PB 5/51 — An attractive clone of average vigour, having a good branching habit and a heavy crown during immaturity. If the trees are planted too close together or if thinning is delayed, the side branches are apt to fall off leaving only the main branches. For this reason it may be better to plant this clone on an avenue system rather than a square system. From commercial records available, this clone is a high yielder though possibly inferior to PB 5/63 in this respect. It appears to be resistant to wind damage. Its latex is suitable for concentration but is yellow and therefore unsuitable for the manufacture of pale crepe without pretreatment.

PB 5/63 — A vigorous clone and said to be the highest yielding clone in the Prang Besar trials. The branching is sometimes forked and the crown is heavy, but the clone appears to be resistant to wind damage. The bark has slightly protuberant buds and those in the upper branches may cause bursts and bleeding. Like that of PB 5/51 its latex is yellow and according to reports may be suitable for concentration.

Ch 26 — A vigorous clone promoted from class III on the strength of records received from Chemara Central Research Station which indicate that it might be in the highest class of yielders. This clone has suffered severely from wind damage on some sites and should not be planted on exposed situations. The latex is currently under test but

previous small scale tests suggest that it may cause difficulty in manufacture of concentrate.

For Experimental Scale Planting

RRIM 600 — Above average for vigour and yield after the second year of tapping of the large scale trial at the RRI Experiment Station. The clone is tall with a fairly heavy crown which does not appear to be susceptible to wind damage. The latex is suitable for pale crepe manufacture but not for concentration.

RRIM 603 — Above average in vigour and yield in the large scale trial. The trees are of medium height and appear to be fairly resistant to wind damage, although some has been recorded. During immaturity the clone may bend when exposed to strong winds but this may be rectified by roping after which it continues its upright growth. The latex is suitable for pale crepe manufacture but not for concentration.

RRIM 605 — The highest yielder of the 600 series clones which are considered promising at present. It is about average in vigour in the trial on our Experiment Station but has shown very good vigour in estate trials. The canopy spreads early during immaturity and casts heavy continuous shade even when planted at forty feet between the rows. It is not susceptible to wind damage. The latex is yellow and not suitable for concentration.

RRIM 606 — Slightly below average in vigour and about average in yield in the large scale trial, but has shown good vigour in estate trials. Its virgin and renewed bark are above average in thickness. The crown is wide and the canopy closes early. The latex is pale yellow and suitable for concentration.

RRIM 607 — Above average in vigour and about average in yield in the large scale trial. The clone has a tight low branching globular head during immaturity, but becomes tall later with few side branches. It is resistant to wind damage. The latex is yellow and suitable for concentration.

RRIM 610 — Above average in yield and below average in vigour in the large scale trial. There are indications that it may grow better on coastal than on inland soils. It has a light crown and is resistant to wind damage. Its virgin and renewed bark are below average thickness in the trial. The latex is deep yellow and is not suitable for concentration.

RRIM 623 — This clone is of the second selection of the 600 series clones and cannot therefore be compared directly at our Experiment Station with the clones mentioned above. It is the most vigorous and one of the highest yielders in the large scale trial of the second selection. Although it has dense branching and foliage the clone appears to be particularly resistant to wind damage. On one RRI trial on coastal soil a series of severe wind storms caused much damage to a number of clones but RRIM 623 and PB 86 escaped. Its virgin and first year's

renewed bark are rather thin. The latex is white and moderately suitable for concentration.

PB T/207 — A vigorous clone with dense windspread branching. The latex has not yet been tested.

PB T/495 — A clone of average to good vigour. From reports on preliminary tests, its latex is yellow and may be of low mechanical stability.

PB 28/83 — A vigorous clone whose canopy closes over early. The latex has not yet been tested.

PB 28/59 — A clone reported to be of less than average vigour on inland soil but vigorous on coastal soils. It has yielded consistently well in trials on Prang Besar Estate and also in an unreplicated plot at the R.R.I. Experiment Station.

PB 5/76 — A vigorous clone which has given consistently good yields in Prang Besar trials.

PB T/157 — A clone of average to good vigour. It has thick bark.

Ch 30 — In trials run by Chemara Central Research Station this clone has outyielded Ch 26 after a number of years although it was a slow starter. It appears to be resistant to wind damage. Its latex is currently under test and from preliminary tests appears to be suitable for all types of manufacture.

Ch 32 — A less vigorous clone than either Ch 26 or Ch 30 and has better bark renewal. Preliminary tests suggest that the latex has low stability.

Nab 12, 15 & 20 — These clones are recommended for planting in a moderate scale in Ceylon where they are all more vigorous than PB 86. They appear to yield about the same as PB 86.

IRCI 7 — This clone is one of the highest yielders of the newer clones recommended in Indochina.

Natural Root Graft

Natural root grafts have previously been reported. The root graft, illustrated, between two surface lateral roots of different trees five years old, is interesting for two reasons. Firstly, it shows how a root that is touching another can in time envelop it. When the photograph was taken the upper root had almost completely grown round the lower one. Secondly, it would appear that the right angle bend in the upper root has resulted from damage by changkol weeding in the planting row. Other bent roots have been observed in the field, particularly at the edge of the clean weeded planting row, but it is not to be expected that the slight damage caused by hand weeding in the planting row will adversely affect tree growth.

The Soil Block Method of Establishing Legume Covers

In Planters' Bulletin 37 and 39 the articles 'Cover Plants – A Discussion' and 'Establishment and Maintenance of Legume Covers' reviewed the desirability of leguminous covers, but admitted the difficulties of establishment and the heavy expenditure required to overcome these. We have pleasure in publishing this contribution from Mr D.A.I. Glennie describing a method which has proved successful in a field trial during an adverse season.

PRINCIPLES

Land should be cleared of weeds and grasses, for instance by spraying, before planting legumes and weeding must be continued until they are established as a cover. If legume seeds are sown in the usual way, germination takes a week to a month, during which period and over several more weeks care must be exercised in weeding to avoid accidental harm to the young seedlings. Furthermore it is unwise to spray after sowing seed. Whereas if established legumes can be planted out the following advantages obtain: all weeds can be eradicated immediately prior to planting, the plants being easily seen, provide centres to weed around with less risk of damage, and moreover several weeks growth are gained towards coverage of the soil.

In the past legumes have been planted in baskets and transferred to the field with the above objects in mind, but baskets are relatively expensive and clumsy to handle. A method of using soil blocks has been developed to overcome the disadvantages of basket planting which also reduces the quantity of expensive seed required to a fraction of that needed for field sowing. A breakdown of the costs shows that the method is economic, and the saving in weeding costs – a heavy item in the practice of normal field sowing – is considerable, producing a balance in favour of the soil block method.

BLOCK MAKING

The writer improvised a machine to make soil blocks for the first trials, but has since designed a suitable machine for service lasting several years, which can be made locally for $160. This can be operated by one person and produces about 300 blocks per hour (*Figure 1*).

A compost of 22 parts good soil, 7 parts cattle manure and 1 part ground rock phosphate is fed down the shute onto the platform of the machine, (*Figure 1*). The cylinder is filled by hand with compost and compressed between plungers, the upper actuated by a hand lever and the lower by a foot pedal. The upper plunger, which presses the compost into a compact soil block against the lower plunger, has a projecting spike which leaves a depression in the soil block. A stroke on

Figures 1 and 2. Block making machine. The upper plunger has been depressed three inches to display its shape.

the foot pedal raises the lower plunger, so lifting the block out of the cylinder, (*Figure 2*). A suitable block diameter is $2\frac{1}{4}$ inches and height $2\frac{1}{4}$ inches.

BOXES

The cylinder is hexagonal and the blocks fit neatly into open boxes. The boxes, which contain 49 blocks each, are made with one side removable to allow easy removal of the floor of the box and of blocks when planting (*Figures 3* and *4*). In this way it is only necessary to have enough complete boxes required for one days planting. The blocks whilst in the nursery are placed on spare box floors. The boxes have raised corners for stacking and easy transport by lorry and can be carried several at a time by one man across the field (*Figures 5* and *6*). 1600 blocks in 33 boxes are required per acre.

ESTABLISHMENT IN THE NURSERY

The seeds are pretreated with concentrated sulphuric acid (see *Planters' Bulletin 39*) then inoculated with Rhizobium compost and placed in a germination box. About 36 hours later the seeds, which are beginning to germinate, are picked off with light forceps and placed singly in the

Figure 3. The parts of a box.

Figure 4. A box assembled.

Figure 5. A stack of boxes.

Figure 6. A labourer carrying four boxes.

Figure 7. Young plant in soil block, note the good root development, it will be ready for transplanting when the next leaf (first trifoliate leaf) expands.

Figure 8. Cover of Pueraria two months after transplanting.

Figure 9. Pueraria nearly two months after transplanting.

Figure 10. Pueraria two weeks after transplanting.

Figures 11 and 12. Cover of Pueraria three months after transplanting.

depressions of the soil blocks and lightly covered with sieved soil. This procedure ensures maximum economy of seed, but no blocks are wasted with inviable seed.

The boxes of blocks are watered gently with a fine spray, then placed under a light shelter to provide shade and watered morning and evening. When the first leaves appear the shade is removed, but if the sun is very strong the shade is replaced in the afternoons for a couple of days until the young plants are hardened. Further shade draws the seedlings so much that they suffer when planted in the field. They should be ready for transplanting about 10 days later. The seedlings may be sprayed with Endrex at the rate of 2 ounces to 4 gallons of water before planting to protect them against beetles.

PLANTING IN THE FIELD

Six inch planting holes are dug 4 ft × 4 ft between the rows of rubber, not closer than 6 ft to the latter. It is essential to dig the holes on the same day or the soil may become too dry. Two labourers per acre may be required if the soil is hard and dry and three more for planting. In areas that have been prepared by mechanical means the labour required may be reduced. *Pueraria phaseoloides* and *Flemingia congesta* are well suited to this type of planting, because both are compact, stocky plants in their early stages and slow to start unless conditions are favourable.

ORGANISATION

This method requires some capital outlay and such factors as the number of boxes available will limit the rate of planting. The boxes come back for re-use after a rotation of about 10 days. However, this may be turned to advantage by planning. The quantity of seed to be acid treated each day is so small that this can be done with safety. The machine and nursery can maintain a steady output of blocks with seedlings for field planting, which is less dependent on weather conditions than with conventional sowing. If the field is planted progressively, the sprayers of weeds, hole diggers, planters of blocks and, later, weeders and distributors of rock phosphate will traverse a new section each day. Thus staggering of the operations means that relatively few labourers are needed at any one time and these may be trained in their particular task.

INITIAL RESULTS

A visitor from the Rubber Research Institute observed the growth two months after the first plantings. There had been little rain, nevertheless the general growth was good (*Figure 8*) and even the more backward plants were well established (*Figure 9*). A young plant of *Pueraria* is shown two weeks after transplanting (*Figure 10*) and *Flemingia*, just dusted with rock phosphate, four weeks after planting out (*Figure 13*).

Figure 13. Flemingia four weeks after transplanting.

There was virtually nothing showing in a portion where seeds were sown in the usual way. The *Pueraria* had established an almost complete cover three months after transplanting (*Figures 11* and *12*).

COSTS

The following estimates are based on a daily wage for male field worker of $2.90, but in practice women may be employed for most of the tasks.

ESTIMATED COST PER ACRE

	$
Depreciation on machine, assume it were written off in 500 acres, although with normal care it should last far longer	0.32
6 cwt of compost, including cartage to nursery site and mixing	1.80
Labour to make 1,600 soil blocks	1.90
Boxes for 100 acres assuming it to be planted in 50 days, boxes rotating in 10 days (total of 66 carrying boxes at 20 cents and 660 box floors at 10 cents)	0.80
Pueraria 1/20 lb assuming 80% germination after acid treatment and cost at $5.60 per lb	0.28
Planting seeds and tending nursery	1.75
Planting blocks in field, assuming 2 male and 3 female workers per acre	12.70
Total:	19.55

Note the acid treatment of the seeds should be done by a responsible person, both for reasons of safety and to ensure correct treatment. This can be combined with a routine supervisory visit.

There are incidentals such as lorry transport to the field to add, which vary with circumstances, but an overall cost of $20 per acre

should not be exceeded; in practice we have operated successfully at $17 per acre employing women where appropriate. Costs of $20 to $30 are quoted for sowing seed at the usual rates in the conventional manner. We estimate that we save the cost of at least two months weeding owing to the more rapid establishment. Weeding and manuring are carried out without difficulty. Drought risks are not serious with this soil block method.

Further economies might be made by using a self-propelled cultivator to dig the planting holes. The type of multi-purpose tool which can be adapted to cut grass, etc. costing up to $500 would be suitable and a useful addition to the estate implements. Unfortunately such a machine was not available during our experiments.

A further possibility is the adaptation of the method to deal with cuttings. Under favourable conditions *Desmodium ovalifolium* is better established from cuttings than from seed. The soil block method may extend the employment of this shade tolerant legume. Seed of *Desmodium* and other legumes such as *Stylosanthes gracilis* and *Psophocarpus palustris*, which planters wish to try, is in limited supply and the soil block method may be of value.

These trials were carried out on Kirby Estate and I wish to record the help and encouragement of my Manager, Mr D. Stewart.

D.A.I Glennie

Spray Nozzles

ALTHOUGH SPRAYING MACHINERY MUST BE CHOSEN carefully to suit conditions of the work in mind this is only a step on the ladder to successful pest or disease control. Equal care should be given to choosing the nozzle. We are, therefore, following up the articles on spraying machinery in *Planters' Bulletins 36* and *39* with an account of spray nozzles.

Nozzles now available can no longer be considered as spouts for the delivery of the spray solution, and the orifice no longer just a hole drilled in the end. They are precision-made for specific purposes and many a failure in control is due to poor spraying – that is, to the wrong choice of nozzle. With the present trend to reduce the amount of sprayed material, the importance of nozzle design gains greater significance.

For many crops the technique of spraying has been carefully worked out, and it is known just how much herbicide, pesticide or fungicide is required to effect control. This is particularly important in low volume spraying or in dealing with toxic substances, an overdose of which might cause unwanted damage. Knowledge of the precise quantity to apply is of little use unless it can be put down accurately in the required pattern and distributed evenly. When applying fungicides and insecticides the aim is to secure a complete film of the material on the leaf

surface. High volume applications achieve this by spraying until run-off occurs, but with low volume spraying the deposit must be such that the drops are discrete and yet form a complete film. Success in low volume spraying has been made possible by nozzle design.

We see, then, that for the best use of the material being applied each operation demands a suitably chosen nozzle.

The term nozzle means more than just the attachment at the end of a lance. Even mist blowers and airblast sprayers have nozzles, albeit of a different form.

Being concerned primarily with nozzles which can be attached to sprayers for use on estates, this article deals mainly with those types suitable for knapsack or boom sprayers, more specialised types being only briefly mentioned. Nozzles most likely to be used on estates can be classified generally according to the pattern of the output – fan, solid cone, hollow cone, and jet (*Figure 1*). Within each class there is almost limitless possibility for variation of drop size, operating pressure, angle of coverage and output.

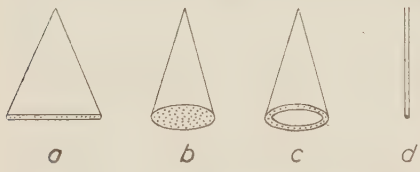

Figure 1. Spray pattern produced by (a) fan (b) solid cone (c) hollow cone (d) jet nozzles.

Basically a nozzle consists of a body, cap, strainer (particularly in low volume nozzles), and interchangeable orifice tip.

Except for airblast nozzles, which are an integral part of the machine, the nozzle types described comprising body, strainer and cap, are precision-made and usually fairly expensive to buy, but the additional cost of orifice tips for different outputs and different spray patterns is small. Being designed to specific standards any interference with them, such as the insertion of larger or smaller washers, may upset the characteristics of the spray. Wear in the orifice produces the same effect and replacement is usually recommended when the output increases by 10% or after about 100 hours spraying.

FAN NOZZLES

The characteristic pattern produced by this type of nozzle is formed either by the spray solution being

Figure 2. Fan type nozzles. The two upper nozzles contain components which can be changed to suit requirements. The two lower ones are examples of inexpensive ceramic tip fan nozzles.

directed against a deflector or by being divided into two streams which impinge upon each other within the nozzle body. Fan nozzles (*Figure 2*), are mostly used on spray booms, but recent advances in design have produced tips for these which make a single nozzle almost equivalent to a boom. One proprietary make has a spray width of 36 feet. The fluid momentum obtained with a fan nozzle – and with a cone type – makes it ideal for penetrating thick foliage.

Fan nozzles give a coarser spray than hollow cone types, and are more prone to blockage, which is not important unless very small quantities of a heavily suspended spray solution are being applied. The orifice tip giving an equivalent output from a hollow cone nozzle would have a larger orifice and therefore is less easily blocked.

A wide range of tips for fan nozzles is available to control output, spray angle and width. The shape of its spray pattern makes this type of nozzle most suitable for applying the spray directly downwards, for example on covers and grasses, while it is moved forward in a straight line. It would be quite unsuitable on the end of a hand lance for spraying seedlings or trees.

CONE NOZZLES

Solid and hollow cone nozzles (*Figure 3*) both produce patterns following the same general principles and it is convenient to consider them together. However, the solid cone type is seldom encountered now in the ordinary small sprayers although it is still favoured for high volume tree and orchard spraying.

Figure 3. Cone nozzles. Examples of cone nozzles and their components. The nozzle (upper right) is the adjustable universal type while that illustrated (upper left) is an example of an adjustable solid cone nozzle. The others all produce the hollow cone pattern.

The spray pattern produced by the hollow cone nozzle is caused by rotation of the spray liquid within the body of the nozzle, before it leaves the orifice, after passing through a swirl plate provided with grooves or channels cut at an inclination. The spray then leaves the orifice in the form of a conical film with an air core in the centre. The solid cone is produced by filling in the centre of this core either by making a central hole in the swirl plate or by providing turbulence within the nozzle. Solid cone nozzles usually give larger drop sizes and

Figure 4. Jet nozzles. Two examples of nozzles which produce jet patterns.

the spray has more drive than from hollow cone nozzles, hence their selection for orchard spraying.

Cone nozzles are not satisfactory at low pressure, but if there is sufficient pressure a great range of spray characteristics can be produced from these nozzles. Alterations in the size, positions and angles of the various holes can give anything from a fine gentle mist to a coarse hard hitting spray. Some manufacturers produce a cone nozzle – so called universal – in which the characteristics of the spray can be altered while spraying and without the need to substitute any part, from a fine mist to a coarse spray, and even to a jet. This is usually achieved by providing some external means of changing the size and shape of the cavity within the nozzle.

The hollow cone nozzle is most commonly used where large quantities of spray are required and in machines designed to operate at high pressures, or where the spray solution contains suspended matter. The larger orifice size of such nozzles of output equivalent to fan nozzles is of advantage in this respect. It is the type of nozzle usually fitted to hand and knapsack sprayers as it is a good general purpose type. It is particularly useful for applying insecticides and fungicides to trees.

JET NOZZLES

The jet is the simplest type of nozzle, consisting merely of a round hole drilled into the end of the nozzle or into a disc which is secured by a threaded cap (*Figure 4*). Although of a simple type, it must be manufactured with care to ensure sharp edges to the hole, which are necessary to provide a perfectly round pattern at all pressures. A

Figure 5. Example of a single delivery jet nozzle in an airblast sprayer.

Figure 6. Nozzle of mist blower showing four delivery jets. These jets deliver the spray into the airblast.

tapered approach to the orifice ensures even flow at low liquid pressures and the spray issuing from such a nozzle is a solid stream which breaks up at some distance from the outlet, through air resistance.

A nozzle of this type is useful where a thin spray stream with maximum throw and minimum atomization is required, for example, in the application of fungicides to control pink disease.

AIRBLAST NOZZLES

Brief mention must be made of the airblast group of nozzles which are finding favour in the small portable power operated mist blowers, whereas previously, they were confined to large tractor drawn orchard sprayers used for blast or drift spraying.

In the various other nozzles that have been discussed pressure is used to atomize the spray by driving it through the nozzle, but in the airblast type the almost stationary liquid is broken up by a large, rapidly moving air mass. Low pressure is used to deliver the spray into the air stream, and the high speed and volume of the air carries the drops to their target. Drops produced by these nozzles are small but they can within limits be controlled, as can the output, by a combined adjustment of the delivery to the jets and of the volume of air passing over them.

Figure 5 shows the nozzle of a power operated, knapsack mist blower, with a single jet delivering spray fluid into the air stream. A more elaborate arrangement with four delivery jets is illustrated in *Figure 6*.

Root Disease and Replanting

We find that some of our readers have misinterpreted the advice on root disease control which we gave in an article in *Planters' Bulletin 35*. They have taken our observation that disease incidence in an experimental area was lowest in the absence of treatment to mean that no treatment of any sort is worth attempting. This is certainly not our view. It is chiefly with regard to the detection of infected trees that our advice has recently changed. Routine rounds of tree-to-tree collar inspection are no longer recommended. We find it better to concentrate on treating the root disease in young replantings as it shows up. The basic principles

of control remain much the same; but, because rounds of foliage inspection are easily made, compared with collar inspection, areas found to be infected can be treated much more promptly. Not only is control work concentrated where it will do most good, but certain undesirable effects of treatment, which seem to increase the incidence of disease, are minimised.

Turning to the method of clearing old rubber prior to replanting, it has been suggested that our advice to burn any timber which is not being carted away for firewood from felled areas is too categorical. We agree. Where root disease is not a problem, and a dense cover of creeping legumes can be established, it is probably unnecessary to burn the surface timber. It can be profitably used to resist soil erosion, and, by its decay, will return a large amount of humus to the soil.

Finally, a small point has been put to us in connection with the method of treating a diseased tree. When a lateral root has to be excised, it is a good policy to prune a branch on the opposite side of the tree to reduce the strain on the remaining roots.

Rooted Clones

A publication in 1951 by L.E. Gregory described how woody cuttings of clone Tjir 1 were induced to root by grafting a bud from a young seedling on to the top of the stem and letting the seedling shoot grow out. An Imperial College of Tropical Agriculture propagator was used to nurse the cuttings during the initial stages.

The original method discovered in tropical America has been modified by P.R. Wycherley at this Institute. The grafting of the seedling bud high on the stem is combined with marcotting lower down. The photograph shows prolific root development from callus above the marcot of a stem of clone PR 107. The first PR 107 self rooted by this method has survived transplanting with continued root growth.

These are the first roots of the clone PR 107 itself in Malaya, thus this method allows cytological examination of root tips of imported clones, whose mother trees and original roots are in foreign countries.

It is acknowledged that this method is too complicated for general use, although it may have some value in preparation of material for cytological investigation and stock-scion experiments.

However, R.J. Garner is now at the R.R.I. Experiment Station seeking simpler means of producing self-rooted clonal material along the lines which he has successfully developed for other tree crops at East Malling Research Station.

American Reaction to TC Rubber

A survey of the position of technically classified (TC) rubber in the U.S.A. was made in September of this year, at our request by the Natural Rubber Bureau, Washington; the findings gathered from manufacturers and members of the rubber trade, are summarised below.

Of the six manufacturing firms interviewed, only one categorically stated that they found no advantage in using TC rubber; none, however, would give the material unqualified support. Three firms mentioned that on ordering, they do not specify TC rubber as such, implying that they take advantage of TC markings occurring in normal supplies.

The opinions confirm the conclusions from a previous, more comprehensive survey in 1956, that manufacturers are reluctant to pay a premium for TC rubber and that the potential demand in the States is for lower grades.

The statements of seven New York rubber importers showed that most of them had regular customers of long standing for TC rubber. Two remarked that no new buyers had entered for the past several months.

Three Shippers' Agents were interviewed, two of whom said they handled a 'fairish volume' whereas one maintained that there was very little interest.

It would appear therefore that the position has remained unchanged over the past two years, the big manufacturers evincing little interest while some of the smaller firms regularly buy a portion of their No. 1 RSS as technically classified.

The Natural Rubber Bureau further draws attention to the difficulty of ascertaining the actual amount of TC rubber imported or sold as neither the trade, the R. M. A., nor the Government give a break down of 'speciality types' in their statistics.

We conclude that no great increase in demand should be anticipated unless more TC rubber, particularly in the lower grades, is made available without premium to manufacturers. The present small but steady consumption may be expected to continue.

Skim Rubber

Due to the steadily growing production of concentrated latex on the plantations, skim rubber, made by coagulating the by-product 'skim' latex, is coming on to the market in increasing quantities. Of necessity from its mode of production, it has an unusually high content of non-rubber substances such as proteins, and hence is liable to behave abnormally and give trouble in manufacturing processes.

As a result of discussions initiated by the tyre manufacturers, the Research Association of British Rubber Manufacturers made a study of the properties of skim rubber and the best ways of using it. These investigations included samples made by special processes designed to reduce the non-rubber content.

This work showed in particular that correct choice of accelerator does much to reduce the scorching tendencies of skim rubber, and that the special processes used in preparing certain of the samples gave them much more nearly normal scorch and cure characteristics. It was further

found that blending with GR-S provides a useful alternative method of using skim rubber; such skim – GR-S blends gave good results in resin – rubber shoe soling compounds, for instance.

This and other useful information concerning skim rubber is set out in full in a report (Research Memorandum R410) issued by the Research Association of British Rubber Manufacturers. A limited number of copies of this report are available at a cost of 5/- each, and can be obtained on application to the Secretary, RABRM, Shawbury, Shrewsbury, Shropshire.

Correspondence

MONKEY DAMAGE

With reference to my correspondence with Pathological Division I would give the following comments for your information.

Monkey traps have been built and placed at known entry points at many points along our jungle boundaries but with very disappointing results. Three or four years ago carbide game-scarers were bought and placed near jungle boundaries, but did not stop the damage. This estate is within hearing distance of a large army training depot and I am of the opinion that monkey tribes in this area (and for that matter other wild game) have become acclimatised to the sound of almost continuous explosions of small-arms ammunition, mortar shells and bombing. Your suggestion of a DDT or Gammexane solution is one method that I have not as yet experimented with and I will be happy to inform you of the results of these experiments. May I also suggest that an appeal for more information on methods for combating monkey damage be inserted in a future *Planters' Bulletin* as I am sure the results of an appeal of this nature would be very interesting to all planters, particularly those in Johore.

Nam Heng Estate

C.W. Hart

Acting Manager

Several enquiries concerning monkey damage have been recieved at the institute recently, especially from Johore. As monkey control is not a subject we can approach experimentally we strongly endorse Mr Hart's wish for planters who have information on controlling monkeys to let us know.—Editor

Journal

The *Journal of the Rubber Research Institute of Malaya* Volume 15 Part 4 contains a paper by Mr M.M. Guha and Dr G.A. Watson which gives the results of some laboratory investigations on the mineralisation of soil nitrogen. These results are providing background information for the Institute's programme of research into the effect of cover plants on soil conditions, and complement the large amount of work now being carried out.

Two papers entitled 'Poisoning Experiments with *Hevea brasiliensis*' Parts I and II. The first paper, by Dr E.D.C. Baptiste, gives a review of experiments which led to the development of sodium arsenite and later of the normal butyl ester of 2,4,5-T as a tree poison. The second paper by Dr E.D.C. Baptiste and Ir P. de Jonge deals in detail with observations made in a poisoning

experiment in which three different grades of gas oil were confounded with two concentrations of 2,4,5-T.

It was found that 5% 2,4,5-T in a thin fluid gas oil was the most effective poison used in the experiment, but did not result in a 100% kill. The results of the experiment and observations elsewhere suggest that trees tapped on several cuts on both sides of the stem react less rapidly to the 2,4,5-T poison than trees tapped on one single half circumference cut. After application of the poison to the unscraped bark, the yield of the trees becomes greatly increased; the period of increase depends on the tapping system used. The kill of the lateral roots was slower than that of the trunks. Sixty per cent of the lateral roots were dead 12 months after poisoning.

A paper by Mr B.C. Sekhar is a preliminary note on the effect of oxygen and amines naturally present in latex on the polyisoprene molecule. The implications of these observations are discussed more thoroughly in two papers by the same author in the July - September issue of *Rubber Chemistry and Technology*.

Dr A. Newsam and Mr B. Sripathi Rao describe recent work with the related insecticides chlordane, aldrin, dieldrin and endrin for use in the control of white ants in a paper entitled 'Control of *Coptotermes curvignathus* Holmgren with Chlorinated Hydrocarbons'. These chlorinated hydrocarbons are effective at low concentrations and retain their activity in the soil for long periods. For this reason, the cost of these insecticides at the low rates of application required is so small, that it is feasible to treat every tree in an infested area and, depending on soil type and insecticide, to give lasting protection. Differences in the effectiveness of the materials and their persistence in different soil types, are discussed.

Mr B.C. Sekhar and Mr G.W. Drake, in another contribution, describe two new processes for making SP rubbers. By the old method, the production of SP rubbers is restricted to the first quality grades only. The new process involves the use of an SP masterbatch containing 90% vulcanised rubber which by admixture allows manufacturers to confer SP properties on all grades of rubber. The paper also describes a process by which SP brown crepe can be manufactured in an estate or remilling factory.

Since submitting the above paper for publication, it has been decided to refer to SP masterbatch as SP 90, which will be used in future in all publications and announcements. At a later date the material will be marketed as SP 90.

Mr K.P. John, in a paper entitled 'Inoculation Experiment with *Fomes lignosus,* Klotzsch', discusses the results of an experiment which was designed to study the growth of *F. lignosus* along artificially inoculated roots when the external growth of the fungus was physically prevented. It was strikingly demonstrated that by preventing external growth the internal spread was virtually halted. The practical significance of this discovery may be great as it encourages the belief that chemical treatments may come to play a part in control measures. The experiment also indicated that wounds and lenticels on roots are more readily invaded than intact bark, and that host resistance may be able to cut off infection.

R. R. I. News

Mr P.S. Nielsen, who joined the staff of the Chemical Division in October, is to take charge of the work on Rubber Testing and Technology.

In 1954 Mr Nielsen was awarded a Diploma of Associateship of the National College of Rubber Technology. After a short period with the Research Institute of the Armed Forces Norway he joined the Mjöndalen Gummivarefabrikk to work on project and compound development.

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Mr K.R. Middleton joined the R.R.I. in October and will be concerned mainly with laboratory investigations in the Soils Division. Mr Middleton graduated from the University of Wales, Aberystwyth and was for a number of years in the Research Division of the Ministry of Agriculture, Sudan Government. Later he worked for the Ministry of Agriculture, Northern Nigeria. He has specialised in the application of analytical chemistry to soil problems and has contributed papers on the subject to journals published by the Society of Chemical Industry. He will study the soil phosphate problem and fluctuations in the nitrogen level of local soils.

o

Mr John Bolton joined the staff of the Soils Division as Agronomist at the end of October. He will be mainly concerned with the field experiment programme. Mr Bolton graduated in Chemistry from Leeds University in 1952 and then followed a postgraduate course in Agricultural Chemistry at the same University. He worked for a year in the Chemistry Department of Rothamsted Agricultural Experiment Station before joining the Department of Agriculture, Barbados. There he was in charge of field experiments on all aspects of sugarcane cultivation and contributed several articles on the subject to local journals.

o

Mr G.H. Tinley joined the staff of the Botanical Division in November and will initially be assisting Mr R.J. Garner to work on the vegetative propagation of rubber and field work.

Mr Tinley graduated in horticulture at Wye College in 1951 and continued research on the growth of fruiting of young apple trees under different systems of soil management gaining his Master of Science degree in Horticulture in 1953. Subsequently he was technical representative of a horticultural firm in the South of England advising glass house, fruit growers and market gardeners.

'Maladies of Hevea in Malaya'

Mr R.N. Hilton of the Pathological Division has now completed publication of a book written in response to the need for an up-to-date reference on diseases of the rubber tree, under the title 'Maladies of Hevea in Malaya'. This volume has been prepared primarily as a recognition manual for the practical planter in Malaya and has been fully illustrated in colour by Mr Hoh Choo Chuan, the Institute's artist and photographer. Copies of the book are expected from the printers soon and will be obtainable from the Institute.

Courses for Senior Estate Conductors

Refresher courses for senior estate conductors are offered this year at the R.R.I. Experiment Station during 4 May to 8 May, 25 May to 29 May, 8 June to 12 June and 22 June to 26 June. Ten conductors can be taken on each course; they must be senior experienced men who are actually in employment, and all applications must be made by the managers of the estates concerned.

The programme will be mainly field work. Demonstrations, talks and lectures will include replanting and new planting procedures, weed control, establishment of legume covers, budgrafting and care of budded stumps, pests and disease treatments, manuring, tapping systems and yield stimulation.

Please apply early, to the Director.

OUR COVER SHOWS A 'NETTLEGRUB', THE CATERPILLAR OF SETORA NITENS, WHICH FEEDS ON MANY CROPS AND COVER PLANTS. THE NUMEROUS BARBED SPINES INFLICT A POISONOUS STING. CONTROL BY SPRAYING WITH ENDRIN.

Photo P.R.W.

The Standard Engravers & Art Printers, 63 Campbell Road, Kuala Lumpur, Selangor